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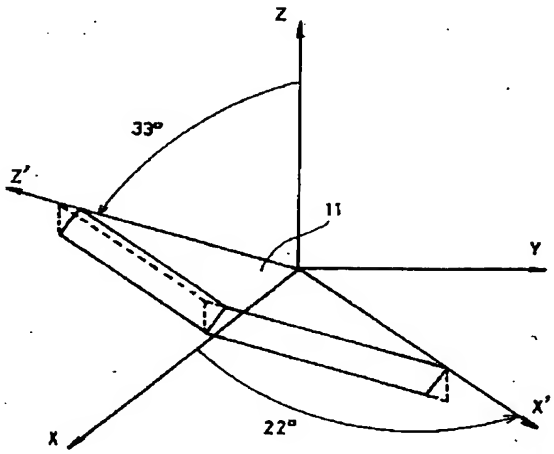
(54)【発明の名称】　ＳＣカットの水晶振動子

(57)【要約】
［目的］　クリスタルインピーダンスが小さく低消費電力で発振可能なＳＣカットの水晶振動子を提供する。
［構成］水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３°回転し更にこの回転した位置からＺＺ'軸を中心にして約２２°回転した面から切り出したＳＣカットの２回回転水晶振動子において、水晶片のＺＺ'軸方向の端面をＸＸ'軸とＺ軸とによって形成される平面に平行に斜めに切断する。



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【特許請求の範囲】

【請求項１】水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３° 回転し、更にこの回転した位置からＺ軸を中心にして約２２° 回転した面から切り出したＳＣカットの２回回転水晶振動子において、

水晶片のＺＺ' 軸方向の端面をＸＸ' 軸とＺ軸によって形成される平面に平行に斜めに切断したことを特徴とするＳＣカットの水晶振動子。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、クリスタルインピーダンス特性の良好なＳＣカットの水晶振動子に関する。

【０００２】

【従来の技術】一般に水晶振動子は、結晶軸に対する切断角度に応じて固有の振動特性を呈する。たとえば数ＭＨｚないし十数ＭＨｚの周波数で最も一般的に使用されるＡＴカットの水晶振動子は２５℃付近に変曲点を有する３次曲線状の温度特性を示す。ところで計測機器、無線機器等で高い安定度の周波数を要求される基準発振器では、たとえば恒温槽型の発振器を用いている。この恒温槽型の発振器では８０℃程度の一定温度に加熱した恒温槽に水晶振動子を収納することにより水晶振動子の温度特性による周波数の変化を除去して安定化を図るものである。そして、このような発振器に適する水晶振動子としてＳＣカットの水晶振動子が知られている。このＳＣカットの水晶振動子１は図４に示すように水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３° 回転し、この回転した位置からＺＺ' 軸を中心にして約２２° 回転した面から、たとえば短冊状に切り出したものである。しかして、このＳＣカットの水晶振動子はＡＴカットの水晶振動子に比して熱衝撃特性が良好で、８０℃前後の比較的高温度においてゼロ温度係数を示し、高いＱ値を得られる。このような特性は、たとえば８０℃程度の一定温度に加熱した恒温槽に収納して使用する安定度の高い水晶発振器としては極めて望ましい特性である。したがって、たとえば１９８０年５月に開催された３４回ＦＣＳ（FREQ.CONTROL SYMPOSIUM）の予稿集の１８７頁ないし１９３頁に基本波モードのＳＣカット共振器（FUNDAMENTAL MODE SC-CUT RESONATORS）として開示されているように種々の報告がなされている。

【０００３】ところで、最近の電子機器の小型化、低消費電力化の傾向にともない、この種の電子機器に使用する水晶振動子も低消費電力で動作することが望まれている。一方、水晶振動子を用いた水晶発振器において消費電力を低減するためには、クリスタルインピーダンス（以下ＣＩと称す）の低い水晶振動子を用いることが極めて有効である。従来、数ＭＨｚないし十数ＭＨｚの周波数帯で最も多用されているＡＴカットの水晶振動子ではＣＩを低くするために短冊状の水晶片の縦横の寸法を最適化し、あるいは振動エネルギを板面の中央部分に閉じこめるために板面の周縁部を斜めに切除するコンベックス加工、板面を凸レンズ状に形成するベベル加工等が行なわれている。しかしながら、ＡＴカットの振動子に用いられていた技術をそのままＳＣカットの水晶振動子に適用することは互いに振動モードが異なるために無理があり、ＳＣカットの水晶振動子においてもＣＩの低い良好な特性のものが望まれていた。

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【０００４】

【発明が解決しようとする課題】本発明は、上記の事情に鑑みてなされたもので、低消費電力で動作可能な発振器に適するＣＩの低いＳＣカットの水晶振動子を提供することを目的とするものである。

【０００５】

【課題を解決するための手段】本発明は、水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３° 回転し更にこの回転した位置からＺＺ' 軸を中心にして約２２° 回転した面から切り出したＳＣカットの２回回転水晶振動子において、水晶片のＺＺ' 軸方向の端面をＸＸ' 軸とＺ軸とによって形成される平面に平行に斜めに切断したことを特徴とするものである。

【０００６】

【実施例】以下、本発明の一実施例を図１に示す水晶片の厚みを誇張した斜視図を参照して詳細に説明する。図中１１はＳＣカットの水晶片である。この水晶片１１は水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３° 、たとえば３３° ３０' 左回転し、更にＺＺ' 軸を中心にして約２２° 、たとえば２２° ３０' 左回転した平面から切り出した２回回転のＳＣカットの水晶片である。そして、この水晶片１１は、そのＺＺ' 軸方向の端面をＸＸ' 軸とＺ軸とによって形成される平面に平行に斜めに切断している。なおこの水晶片１１を水晶振動子として用いる場合は、表裏主面に、たとえばアルミニウム、銀等の導電性の金属を蒸着して金属薄膜からなる励振電極を形成し、該電極を発振回路等に接続して用いるようにしている。

【０００７】５．０ｍｍ×２．５ｍｍの大きさの短冊型のＳＣカットの水晶片で基本波の共振周波数１６．９ＭＨｚのサンプル２０個づつについて、従来のようにＺＺ' 軸方向の端部を主面に直角に切断したものと、本発明によるＺＺ' 軸方向の端面をＸＸ' 軸とＺ軸とによって形成される平面に平行に斜めに切断したものとの特性を測定した。この結果、従来のものではＣＩ値の平均は５６．３Ω、標準偏差は４．２であった。これに対して本発明によるサンプルでは、ＣＩ値の平均は３８．１Ω、標準偏差は１．２であった。したがって本発明によればＣＩ値は従来のそれの約２／３の小さな値となり、しかも標準偏差も小さく特性のばらつきも少ないＳＣカットの水晶振動子をえられる。

【０００８】

【発明の効果】以上詳述したように本発明によれば、Ｃ

Ｉが小さく低消費電力で動作可能な発振器に適し、特性のばらつきも少ないＳＣカットの水晶振動子を提供することができる。

【０００９】

【図面の簡単な説明】

＊【図１】本発明の水晶振動子の切断角度を説明する斜視図である。

【符号の説明】

１１　　水晶片

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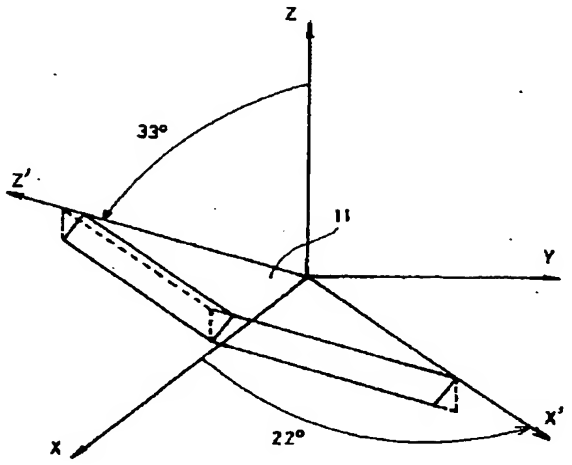
【図１】



PATENT ABSTRACTS OF JAPAN

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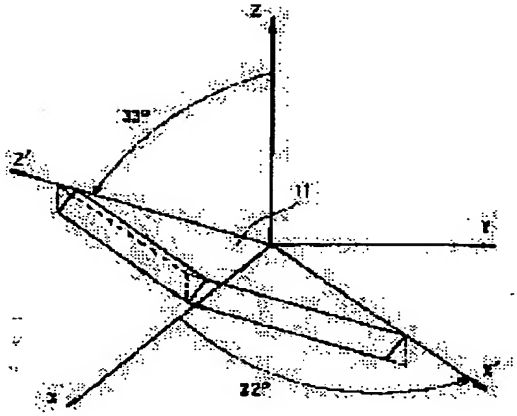
(71)Applicant : NIPPON DEMPA KOGYO CO LTD
(72)Inventor : KOYAMA MITSUAKI

(54) CRYSTAL OSCILLATOR FOR SC CUT

(57)Abstract:
PURPOSE: To obtain a SC cut crystal oscillator to be oscillated with a small crystal impedance and low energy consumption.
CONSTITUTION: At an SC cut double rotation crystal oscillator 11 rotating a place orthogonal to the Y axis of crystal about at 33° with the X axis as a center and further being segmented from a place rotated about at 22° from this rotated position with a ZZ' axis as a center, the end face of a crystal piece in the ZZ' direction is obliquely cut parallelly to a plane formed by the XX' and Z axes.



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[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] The quartz resonator of SC cut characterized by to cut aslant the end face of ZZ' shaft orientations of the piece of Xtal in parallel at the flat surface formed of XX' shaft and the Z-axis in the 2 times rotation quartz resonator of SC cut started from the field which rotated about 33 degrees of fields which intersect perpendicularly with the Y-axis of the crystal of Xtal focusing on the X-axis, and was further rotated about 22 degrees focusing on the Z-axis from this rotated location.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the quartz resonator of good SC cut of a crystal impedance characteristic.
[0002]
[Description of the Prior Art] Generally a quartz resonator presents the oscillation characteristic of a proper according to the cutting include angle to a crystallographic axis. For example, the quartz resonator of the AT cut most generally used on the frequency of several MHz thru/or about tenMHz shows the temperature characteristic of the shape of 3rd curve which has point of inflection near 25 degree C. By the way, in the criteria oscillator of which the frequency of high stability is required by the measuring machine machine, a wireless device, etc., the oscillator of a thermostat mold is used, for example. In this thermostat type of oscillator, by containing a quartz resonator to the thermostat heated in constant temperature of about 80 degrees C, change of the frequency by the temperature characteristic of a quartz resonator is removed, and stabilization is attained. And the quartz resonator of SC cut is known as a quartz resonator suitable for such an oscillator. The quartz resonator 1 of this SC cut is cut down, for example in the shape of a strip of paper from the field which rotated about 33 degrees of fields which intersect perpendicularly with the Y-axis of the crystal of Xtal focusing on the X-axis as shown in drawing 4, and was rotated about 22 degrees centering on ZZ' shaft from this rotated location. a deer — carrying out — the quartz resonator of this SC cut — the quartz resonator of an AT cut — comparing — a thermal shock property — good — 80-degree-C order — in high temperature, a zero temperature coefficient is shown comparatively, and high Q value can be obtained. Such a property is a property very desirable as a crystal oscillator with the high stability contained and used for the thermostat heated in constant temperature of about 80 degrees C. Various reports are made as indicated by 187 pages of the collection of drafts of FCS (FREQ.CONTROL SYMPOSIUM) thru/or 193 pages 34 times which followed, for example, was held in May, 1980 as an SC cut resonator (FUNDAMENTAL MODE SC-CUT RESONATORS) in fundamental-wave mode.
[0003] By the way, in connection with the inclination of the miniaturization of the latest electronic equipment, and low-power-izing, the quartz resonator used for this kind of electronic equipment is also wanted to operate with a low power. It is very effective to, use a quartz resonator with a low crystal impedance (for Following CI to be called) on the other hand, in order to reduce power consumption in the crystal oscillator using a quartz resonator. Conventionally, in the quartz resonator of the AT cut currently most used abundantly with the frequency band (several MHz thru/or about tenMHz), since the dimension of a strip-of-paper-like the piece of Xtal in every direction is optimized in order to make CI low, or vibrational energy is confined in the central part of a plate surface, convex processing which excises the periphery section of a plate surface aslant, bevel processing which forms a plate surface in the shape of a convex lens are performed. However, since the oscillation modes differ mutually, it is impossible to apply the technique used for the vibrator of an AT cut to the quartz resonator of SC cut as it is, and a thing of the low good property of CI was desired also in the quartz resonator of SC cut.
[0004]

[Problem(s) to be Solved by the Invention] This invention was made in view of the above-mentioned situation, and aims at offering the quartz resonator of low SC cut of CI suitable for the oscillator which can operate with a low power.
[0005]
[Means for Solving the Problem] In the 2 times rotation quartz resonator of SC cut started from the field which this invention rotated about 33 degrees of fields which intersect perpendicularly with the Y-axis of the crystal of Xtal focusing on the X-axis, and was further rotated about 22 degrees centering on ZZ' shaft from this rotated location It is characterized by cutting aslant the end face of ZZ' shaft orientations of the piece of Xtal in parallel at the flat surface formed of XX' shaft and the Z-axis.
[0006]
[Example] It explains to a detail with reference to the perspective view which exaggerated hereafter the thickness of the piece of Xtal which shows one example of this invention to drawing 1 . 11 in drawing is the piece of Xtal of SC cut. the field where the Y-axis of the crystal of Xtal and this piece 11 of Xtal cross at right angles — a core [X-axis] — carrying out — about 33 degrees, for example, a 33-degree30' RLC, — carrying out — further — ZZ' — a core [shaft] — carrying out — about 22 degrees, for example, 22degree30', — it is the piece of Xtal of SC cut of the 2 times rotation started from the flat surface which carried out the RLC. And this piece 11 of Xtal is cutting that end face of ZZ' shaft orientations aslant in parallel at the flat surface formed of XX' shaft and the Z-axis. In addition, when using this piece 11 of Xtal as a quartz resonator, the excitation electrode which vapor-deposits conductive metals, such as aluminum and silver, to a front flesh-side principal plane, and becomes it from a metal thin film is formed, and he connects with an oscillator circuit etc. and is trying to use this electrode.
[0007] The property of what cut the edge of ZZ' shaft orientations at a time at the right angle like before about 20 samples with a resonance frequency [of a fundamental wave] of 16.9MHz at the principal plane by the piece of Xtal of SC cut of the stick-shape of 5.0mmx2.5mm magnitude, and the thing which cut aslant the end face of ZZ' shaft orientations by this invention in parallel at the flat surface formed of XX' shaft and the Z-axis was measured. Consequently, in the conventional thing, the average of CI value was 56.3 ohms and standard deviation was 4.2. On the other hand, with the sample by this invention, the average of CI value was 38.1 ohms and standard deviation was 1.2. therefore — according to this invention — about [of the former / value / CI / of that] — it becomes two thirds of small values, and, moreover, the quartz resonator of SC [with small standard deviation] cut also with little dispersion in a property can be obtained.
[0008]
[Effect of the Invention] As explained in full detail above, according to this invention, CI is suitable for the small oscillator to which it can operate with a low power, and dispersion in a property can also offer the quartz resonator of little SC cut.
[0009]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is a perspective view explaining the cutting include angle of the quartz resonator of this invention.
[Description of Notations]
11 Piece of Xtal

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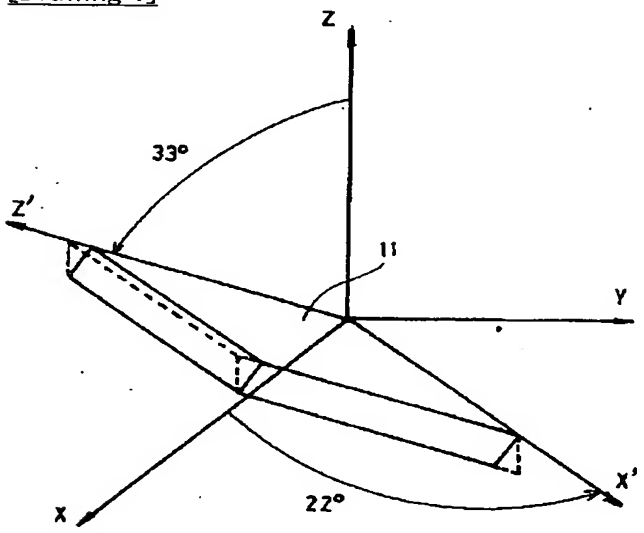
DRAWINGS

[Drawing 1]



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